

PANTROPICAL SPOTTED DOLPHIN (*Stenella attenuata attenuata*): Hawaiian Islands Stock Complex – Oahu, 4-Islands, Hawaii Island, and Hawaii Pelagic Stocks

STOCK DEFINITION AND GEOGRAPHIC RANGE

Pantropical spotted dolphins are primarily found in tropical and subtropical waters worldwide (Perrin *et al.* 2009). Much of what is known about the species in the North Pacific has been learned from specimens obtained in the large directed fishery in Japan and in the eastern tropical Pacific (ETP) tuna purse-seine fishery (Perrin *et al.* 2009). Spotted dolphins are common and abundant throughout the Hawaiian archipelago, including nearshore where they are the second most frequently sighted species during nearshore surveys (Baird *et al.* 2013). Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands resulted in 14 sightings in 2002, 49 sightings in 2010, and 25 sightings in 2017 (Barlow 2006, Bradford *et al.* 2017, Yano *et al.* 2018; Figure 1). Morphological differences and distribution patterns indicate that the spotted dolphins around the Hawaiian Islands belong to a stock that is distinct from those in the ETP (Perrin 1975; Dizon *et al.* 1994; Perrin *et al.* 1994b).

Pantropical spotted dolphins have been observed in all months of the year around the main Hawaiian Islands, and in areas ranging from shallow near-shore water to depths of 5,000 m, although they peak in sighting rates in depths from 1,500 to 3,500 m (Baird *et al.* 2013). Although they represent from 22.9 to 26.5% of the odontocete sightings from Oahu, the 4-islands, and Hawaii Island, they are largely absent from the nearshore waters around Kauai and Niihau, representing only 3.9% of sightings in that area (Baird *et al.* 2013). Genetic analyses of 176 unique samples of pantropical spotted dolphins collected during near-shore surveys off each of the main Hawaiian Islands from 2002 to 2003, and near Hawaii Island from 2005 through 2008 suggest three island-associated stocks are evident (Courbis *et al.* 2014). The results of the Courbis *et al.* (2014) study indicate that pantropical spotted dolphins in Hawaii's nearshore waters have low haplotypic diversity with haplotypes unique to each of the island areas. Courbis

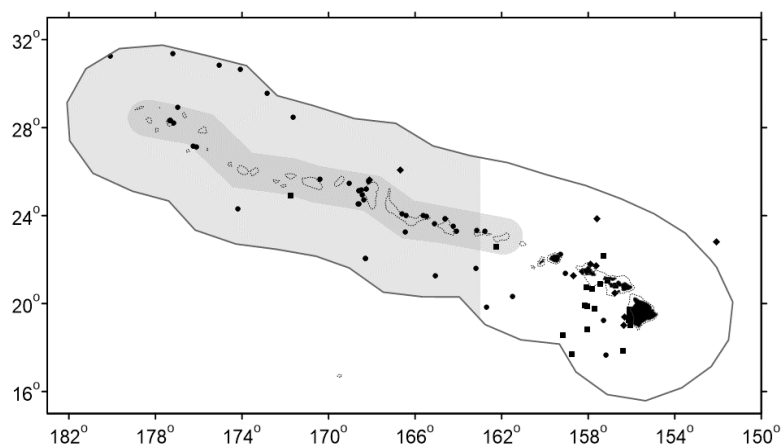


Figure 1. Pantropical spotted dolphin sighting locations during the 2002 (diamonds), 2010 (circle), and 2017 (square) shipboard surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford *et al.* 2017, Yano *et al.* 2018). Outer line represents approximate boundary of survey area and U.S. EEZ. Dark gray shading indicates the original Papahānaumokuākea Marine National Monument, with the lighter gray shading denoting the full 2016 Expansion area. Dotted line represents the 1000 m isobath. Insular stock boundaries are shown in Figure 2.

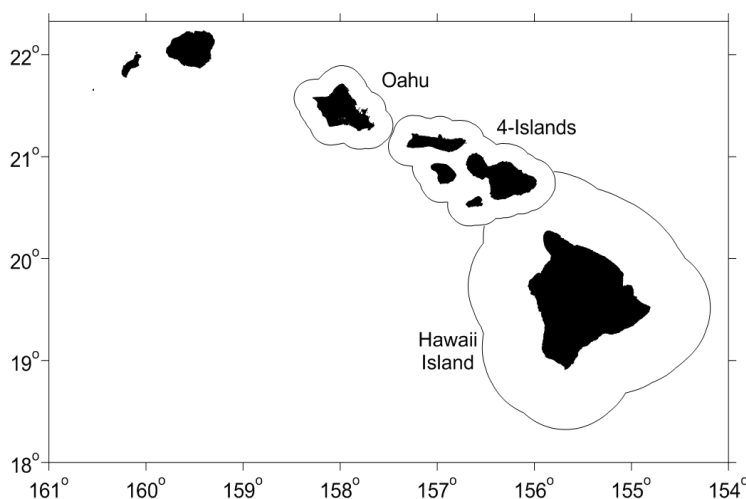


Figure 2. Main Hawaiian Islands insular spotted dolphin stock boundaries (gray lines). Oahu and 4-Islands stocks extend 20 km from shore. Hawaii Island stock extends to 65km from shore based on distance of furthest encounter.

et al. (2014) conducted extensive tests on the relatedness of individuals among islands using the microsatellite dataset and found significant differences in haplotype frequencies between islands, suggesting genetic differentiation in spotted dolphins among islands. This suggestion is supported by the results of assignments tests, which indicate support for 3 island-associated populations: Hawaii Island, the 4-Islands region, and Oahu. Samples from Kauai and Niihau did not cluster together, but instead were spread among the Hawaii and Oahu clusters. Analysis of migration rate further support the separation of pantropical spotted dolphins into three island-associated stocks, with migration between regions on the order of a few individuals per generation. Based on an overview of all available information on pantropical spotted dolphins in Hawaiian waters, and NMFS guidelines for assessing marine mammal stocks (NMFS 2005), Oleson *et al.* (2013) proposed designation of three new island associated stocks in Hawaiian waters, as well as recognition of a fourth broadly distributed spotted dolphin stock given the frequency of sightings in pelagic waters. Fishery interactions with pantropical spotted dolphins and sightings near Palmyra and Johnston Atolls (NMFS PIR unpublished data) demonstrate that this species also occurs in U.S. EEZ waters there, but it is not known whether these animals are part of the Hawaiian population or are a separate stock or stocks of pantropical spotted dolphins.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are four Pacific management stocks within the Hawaiian Islands EEZ (Oleson *et al.* 2013): 1) the Oahu stock, which includes spotted dolphins within 20km of Oahu, 2) the 4-Island stock, which includes spotted dolphins within 20 km of Maui, Molokai, Lanai, and Kahoolawe collectively, 3) the Hawaii Island stock, which includes spotted dolphins found within 65km from Hawaii Island, and 4) the Hawaii pelagic stock, which includes spotted dolphins inhabiting the waters throughout the Hawaiian Islands EEZ, outside of the insular stock areas, but including adjacent high seas waters. Because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of the Hawaii pelagic stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005). Spotted dolphins involved in eastern tropical Pacific tuna purse-seine fisheries are managed separately under the MMPA.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Entanglement in gillnets and hooking or entanglement in various hook and line fisheries have been reported for small cetaceans in Hawaii (Nitta and Henderson 1993). No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line or gillnet fisheries because these fisheries are not observed or monitored for protected species bycatch. Commercial and recreational troll fisherman have been observed “fishing” dolphins off the islands of Hawaii, Lanai, and Oahu, including spotted dolphins, in order to catch tuna associated with the animals (Courbis *et al.* 2009, Rizzuto 2007, Shallenberger 1981). Anecdotal reports from fisherman indicate that spotted dolphins are sometimes hooked (Rizzuto 1997) and photographs of dolphins suggest animals may be injured by both lines and propeller strikes (Baird unpublished data). In 2014, a spotted dolphin (Hawaii Island stock) was observed hooked above the jaw and trailing 8-10 feet of fishing line (Bradford and Lyman 2018). In 2017, a spotted dolphin (4 Islands stock) was seen near Lanai with a band of debris around its rostrum, preventing it from opening its mouth (Bradford and Lyman 2019). Based on the information provided, both of these injuries are considered serious injuries. The responsible fishery is not known for either case.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2014 and 2018, no pantropical spotted dolphins were observed hooked or entangled in the SSL fishery (100% observer coverage) or in the DSL fishery (18-21% observer coverage) (Bradford 2018a, 2018b, 2020, Bradford and Forney 2017). Three additional unidentified delphinids were taken in the DSL fishery, some of which may have been spotted dolphins.

OAHU STOCK

POPULATION SIZE

The population size of the Oahu stock of spotted dolphins has not been estimated.

Minimum Population Estimate

There is no information on which to base a minimum population estimate of the Oahu stock of spotted dolphins.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Oahu stock is calculated as the minimum population estimate times one half the default maximum net growth rate for cetaceans ($\frac{1}{2}$ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no estimated fishery mortality or serious injury within the Oahu stock area; Wade and Angliss 1997). Because there is no minimum population estimate available the PBR for Oahu stock of spotted dolphins is undetermined.

STATUS OF STOCK

The Oahu stock of spotted dolphins is not considered a strategic stock under the MMPA. The status of Oahu spotted dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance for this stock. Spotted dolphins are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor designated as “depleted” under the MMPA. There is no information with which to determine whether the total fishery mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. *Morbillivirus* has been detected within other insular stocks of pantropical spotted dolphins in Hawaii (Jacob *et al.* 2016). The presence of *morbillivirus* in 10 species of cetacean in Hawaiian waters raises concerns about the history and prevalence of this disease in Hawaii and the potential population impacts, including the cumulative impacts of disease with other stressors.

4-ISLANDS STOCK

POPULATION SIZE

The population size of 4-Islands stock of spotted dolphins has not been estimated.

Minimum Population Estimate

There is no information on which to base a minimum population estimate of the 4-Islands stock of spotted dolphins.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the 4-Islands stock is calculated as the minimum population estimate times one half the default maximum net growth rate for cetaceans ($\frac{1}{2}$ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no estimated fishery mortality or serious injury within the 4-Islands stock area; Wade and Angliss 1997). Because there is no minimum population estimate available for this stock the PBR for 4-Islands stock of spotted dolphins is undetermined.

STATUS OF STOCK

The 4-Islands stock of spotted dolphins is not considered a strategic stock under the MMPA. The status of 4-Islands spotted dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance for this stock. Spotted dolphins are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor designated as “depleted” under the MMPA. There are insufficient data available to determine whether the total fishery mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. *Morbillivirus* has been detected within other insular stocks of pantropical spotted dolphins in Hawaii (Jacob

et al. 2016). The presence of *morbillivirus* in 10 species of cetacean in Hawaiian waters raises concerns about the history and prevalence of this disease in Hawaii and the potential population impacts, including the cumulative impacts of disease with other stressors.

HAWAII ISLAND STOCK

POPULATION SIZE

The population size of the Hawaii Island stock of spotted dolphins has not been estimated. An extensive collection of identification photos from this population are available; however, a photo-identification catalog has not been developed. Such a catalog could serve as the basis for developing mark-recapture estimates, but no such analyses have yet been conducted.

Minimum Population Estimate

There is no information on which to base a minimum population estimate of the Hawaii Island stock of spotted dolphins.

Current Population Trend

No data are available on current population trend.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii Island stock is calculated as the minimum population estimate times one half the default maximum net growth rate for cetaceans ($\frac{1}{2}$ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no estimated fishery mortality or serious injury within the Hawaii Island stock area; Wade and Angliss 1997). Because there is no minimum population estimate available for this stock the PBR for Hawaii Island stock of spotted dolphins is undetermined.

STATUS OF STOCK

The Hawaii Island stock of spotted dolphins is not considered a strategic stock under the MMPA. The status of Hawaii Island spotted dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance for this stock. Spotted dolphins are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor designated as “depleted” under the MMPA. Although one dolphin has been considered seriously injured due to an interaction with fishing gear, there are insufficient data to determine whether the total fishery mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. One spotted dolphin found stranded on Hawaii Island has tested positive for *Morbillivirus* (Jacob *et al.* 2016). The presence of *morbillivirus* in 10 species of cetacean in Hawaiian waters (Jacob 2012) raises concerns about the history and prevalence of this disease in Hawaii and the potential population impacts, including the cumulative impacts of disease with other stressors.

HAWAII PELAGIC STOCK

POPULATION SIZE

Encounter data from shipboard line-transect surveys of the entire Hawaiian Islands EEZ were recently reevaluated for each survey year, resulting in the following abundance estimates of spotted dolphins in the Hawaii EEZ (Bradford *et al.* 2021; Table 1).

Table 1. Line-transect abundance estimates for spotted dolphins derived from surveys of the entire Hawaii EEZ in 2002, 2010, and 2017 (Bradford *et al.* 2021).

Year	Abundance	CV	95% Confidence Limits
2017	39,798	0.51	15,432-102,637

2010	49,488	0.39	23,551-103,992
2002	16,931	0.65	5,289-54,202

The updated design-based abundance estimates use sighting data from throughout the central Pacific to estimate the detection function and use Beaufort sea-state-specific trackline detection probabilities for spotted dolphins from Barlow *et al.* (2015). Although previous estimates from the Hawaii EEZ have been published using subsets of this data, Bradford *et al.* (2021), uses a consistent approach for estimating all abundance parameters and resulting estimates are considered the best available. Model-based abundance estimates are available for all survey years (Becker *et al.* 2021), but are derived from sightings representing all spotted dolphin stocks within the Hawaiian islands, as removal of sightings of island-associated stock individuals would leave insufficient sample size to derive a robust model. Model covariates may not accurately reflect the habitat associations of pelagic spotted dolphins given the large number of insular sightings used in model development. Because the model is not stock-specific and pelagic stock abundance cannot be reliably extracted from model outputs, the design-based estimates are considered the best available for the pelagic stock. The best estimate of abundance for this stock is from the 2017 survey, or 39,798 (CV=0.51). Population estimates are available for Japanese waters (Miyashita 1993), but it is not known whether any of these animals are part of the same population that occurs around the Hawaiian Islands.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow *et al.* 1995) of the 2017 abundance estimate for the pelagic stock area or 26,548 pantropical spotted dolphins.

Current Population Trend

The three available abundance estimates for this stock have very broad and overlapping confidence intervals, precluding robust evaluation of population trend for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii pelagic pantropical spotted dolphin stock is calculated as the minimum population estimate within the U.S. EEZ of the Hawaiian Islands (26,548) times one half the default maximum net growth rate for cetaceans ($\frac{1}{2}$ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality within the U.S. EEZ of the Hawaiian Islands; Wade and Angliss 1997), resulting in a PBR of 265 pantropical spotted dolphins per year.

STATUS OF STOCK

The Hawaii pelagic stock of spotted dolphins is not considered strategic under the 1994 amendments to the MMPA. The status of Hawaii pelagic pantropical spotted dolphins relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Pantropical spotted dolphins are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor designated as “depleted” under the MMPA. Given the absence of recent recorded fishery-related mortality or serious injuries within U.S. EEZs, the total fishery mortality and serious injury can be considered to be insignificant and approaching zero. *Morbillivirus* has been detected within other insular stocks of bottlenose dolphins in Hawaii (Jacob *et al.* 2016). The presence of *morbillivirus* in 10 species of cetacean in Hawaiian waters raises concerns about the history and prevalence of this disease in Hawaii and the potential population impacts, including the cumulative impacts of disease with other stressors.

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